Combustion Technology University Alliance Workshop

Topic:

Utility Perspective on R&D Needs: A View from the Coal Utilization Research Council

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Observations:

- The importance of being relevant
- Institutions of higher education are the seed corns of –
  - Novel ideas and basic and applied research
  - Graduates who will lead through transitions in the industry

Topics to be addressed

- The path to technology commercialization
  - The typical path from R&D to commercialization
  - The Clean Coal Technology Roadmap
- The Partnership roles of government & industry
  - Research & Development
  - Demonstrations
  - Deployment
- Comprehensive national energy legislation

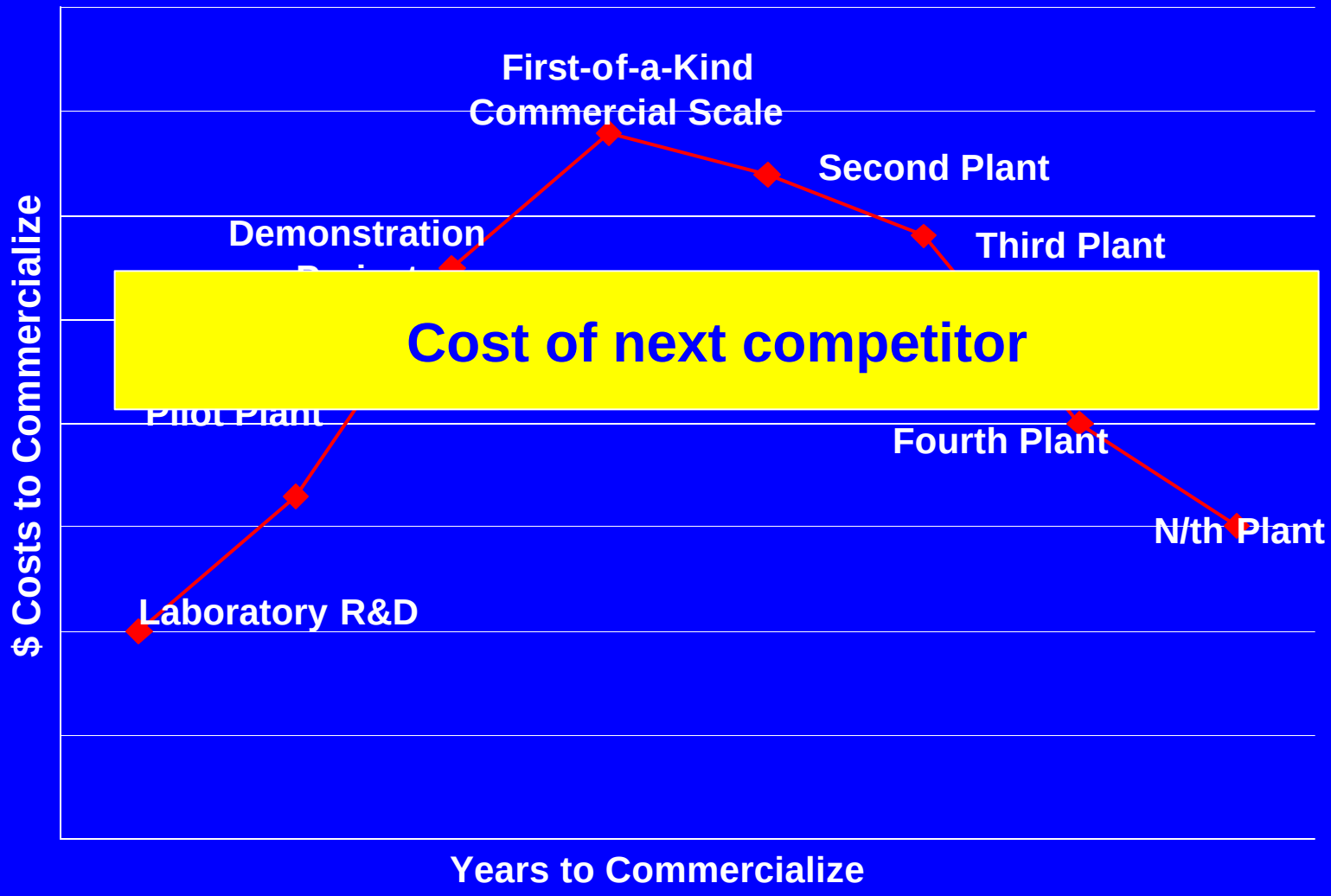
To insure that coal can meet challenges now and in the future

- **Technology is essential**

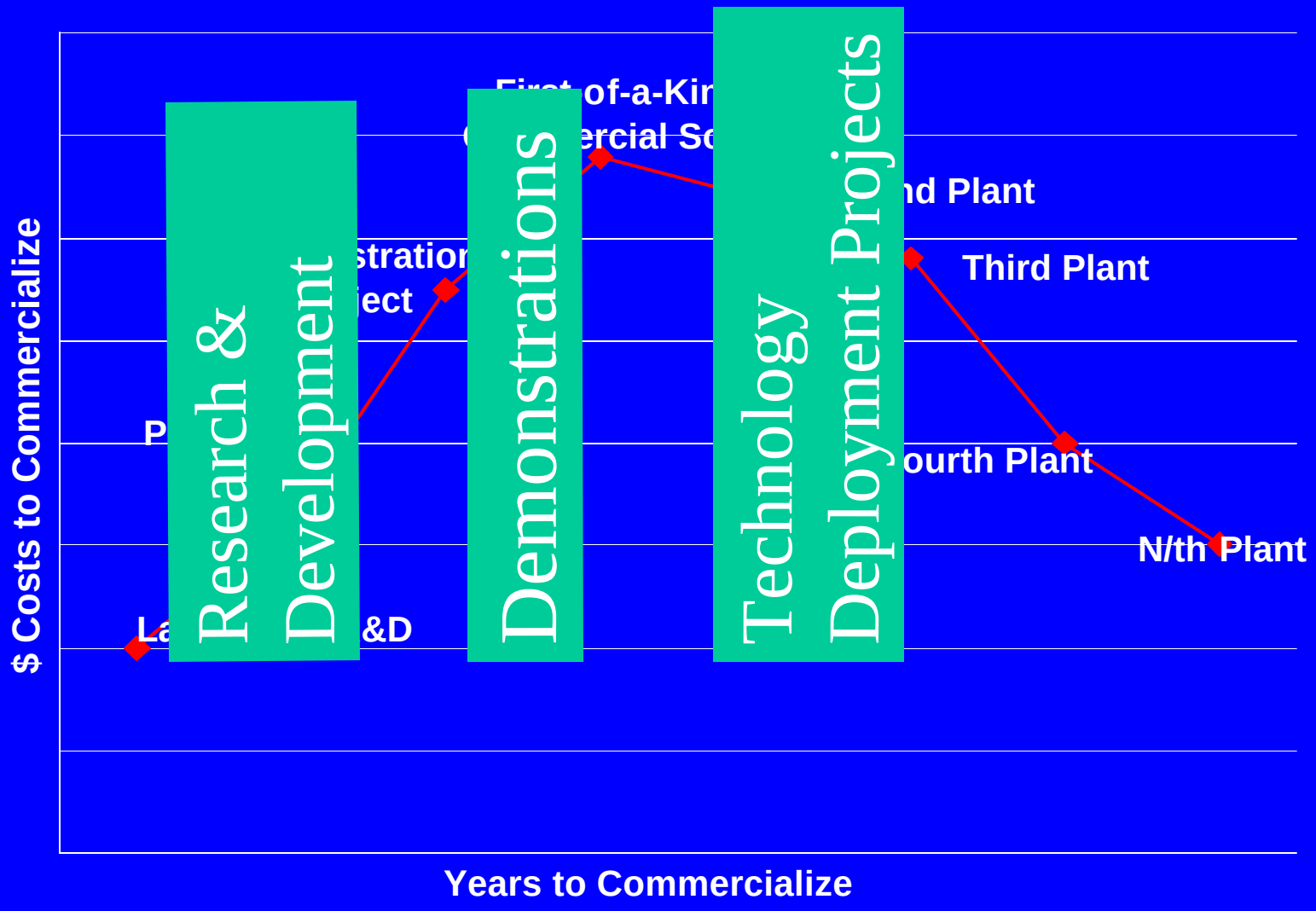
- **Technology must be --**
  - **Cost competitive**
  - **Meet environmental standards**

- **Technology becomes a means by which --**
  - **to insure coal's competitiveness**
  - **to remove environmental issues as a concern for future coal use**

Technology R&D to Commercialization



Technology R&D to Commercialization



Clean Coal Technology Roadmap

The Agreement of CURC, DOE & EPRI

Th tment of Energy, the Electric Power Research Institute,
and the Coal Utilization Research Council

Roadmap Performance Targets

(Represents best integrated plant technology capability)

	Reference Plant*	2010	2020
Air Emissions			>99%
			<0.01 lb/10^6 Btu
			002 lb/10^6 Btu
			95% removal
By-Product Utilization	30%		near 100%(6)

Goal is to achieve Near Zero Emissions from Coal Use

*Reference plant has performance typical of today's technology; Improved performance achievable with cost/efficiency tradeoffs.

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Roadmap Performance Targets[(1)]

(Represents best integrated new plant technology capability)

	2010	2020
Pl		50-60%
		≥90%
		800 – 900
		<3.0

Goal is to achieve very high efficiency, low capital costs and low priced electricity

(1) Targets are w/ …d reflect current cooling tower technology for water use

(2) Range reflects performance projected for different plant technologies that will achieve environmental performance and energy cost targets

(3) Percent of time capable of generating power (ref. North American Electric Reliability Council)

(4) Bus-bar cost-of-electricity in today's dollars; Reference plant based on $1000/kW capital cost, $1.20/$10^6$ Btu coal cost

Roadmap Targets for CO_2 Management

- Carbon manage… …arbon-based fuels; dir…
- Co… …al
- Miles…
  - Field… dem… …n(s) … …ol (2010)
  - De… …trate energy plants integrated with c…pture/sequestration meeting program cost goal (2020)

Goal is to develop technologies & know-how to cost-effectively prevent, capture and sequester CO_2

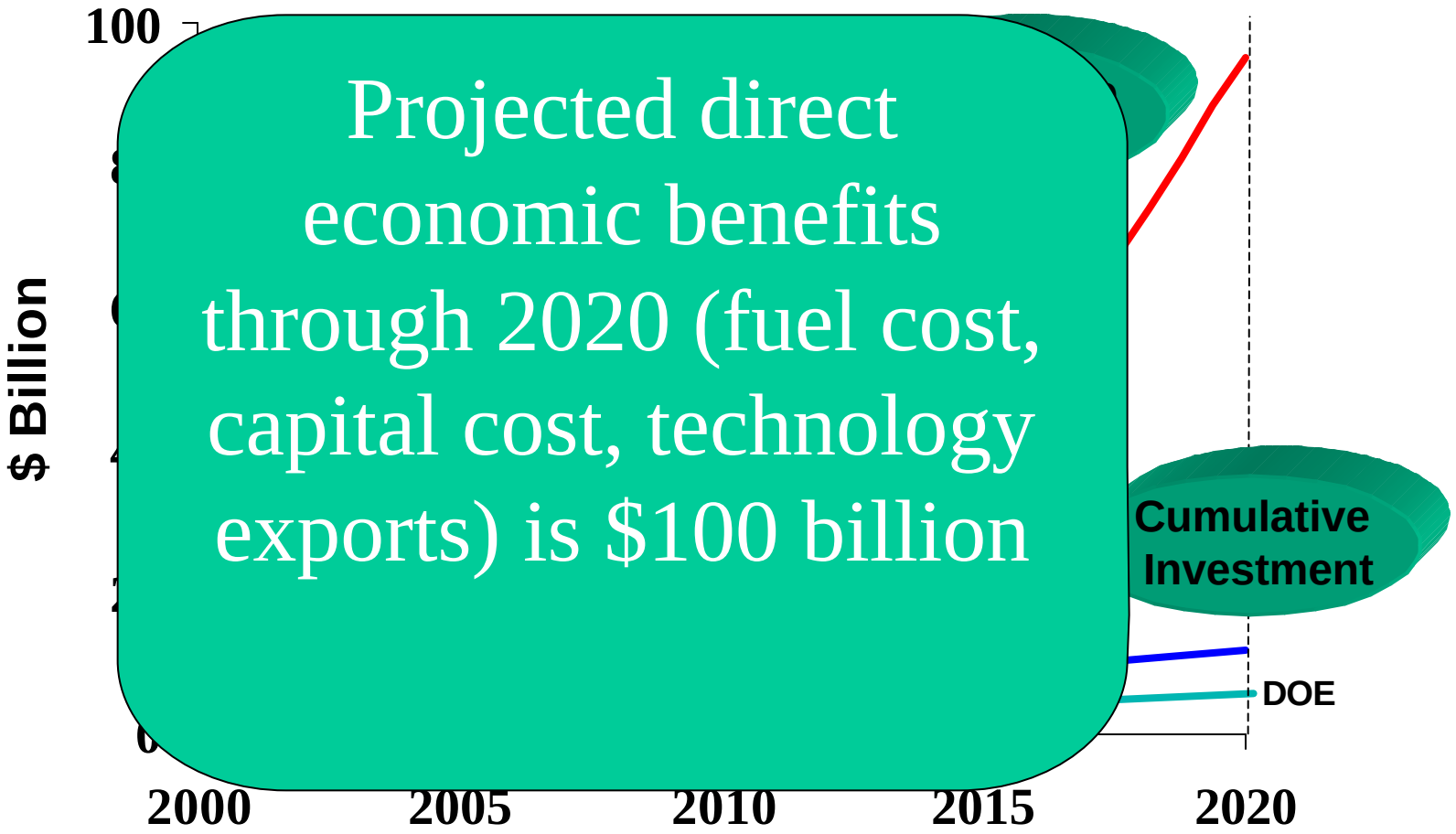
Roadmap - Benefits/Investment ($ million)

	(t
Investment[1,2]	
R&D	
Demonstration	
Total	1 00
Economic Benefit[3]	100,000
Benefit/Investment Ratio	~10

Public & private investment to 2020: $10.+ B* (*does not include cost of carbon mgt RD&D)

1 Current year $; Includes DOE + private sector investment
2 Investment does not include carbon sequestration; sequestration investment and benefits are applicable to coal program and other processes using carbon-based fuels; cumulative anticipated investment to 2020 is ~$4 billion
3 Assumes existing plant improvements dominate from today-2010 and new plant benefits dominate from 2010-2020

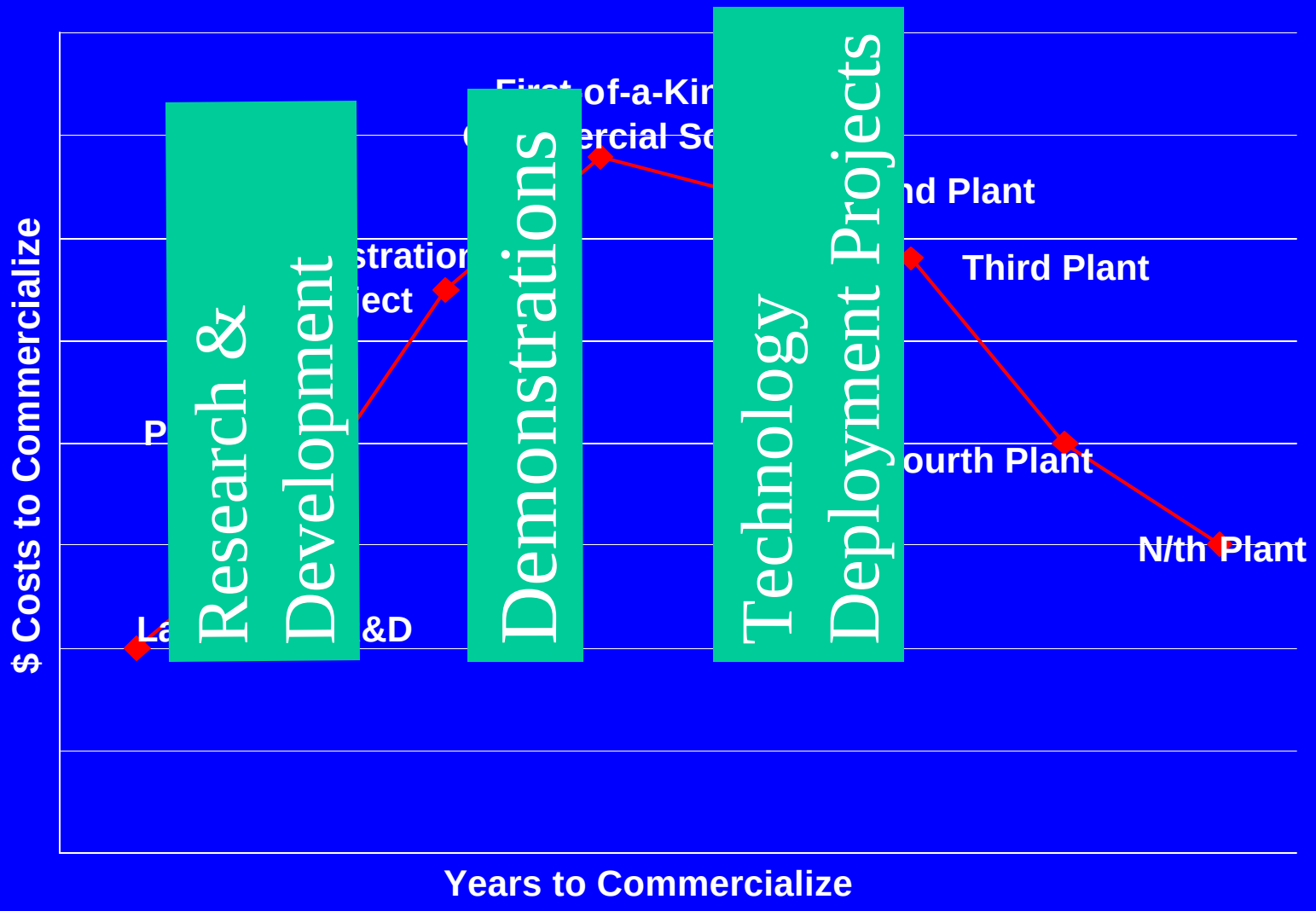
Roadmap - Benefits/Investment



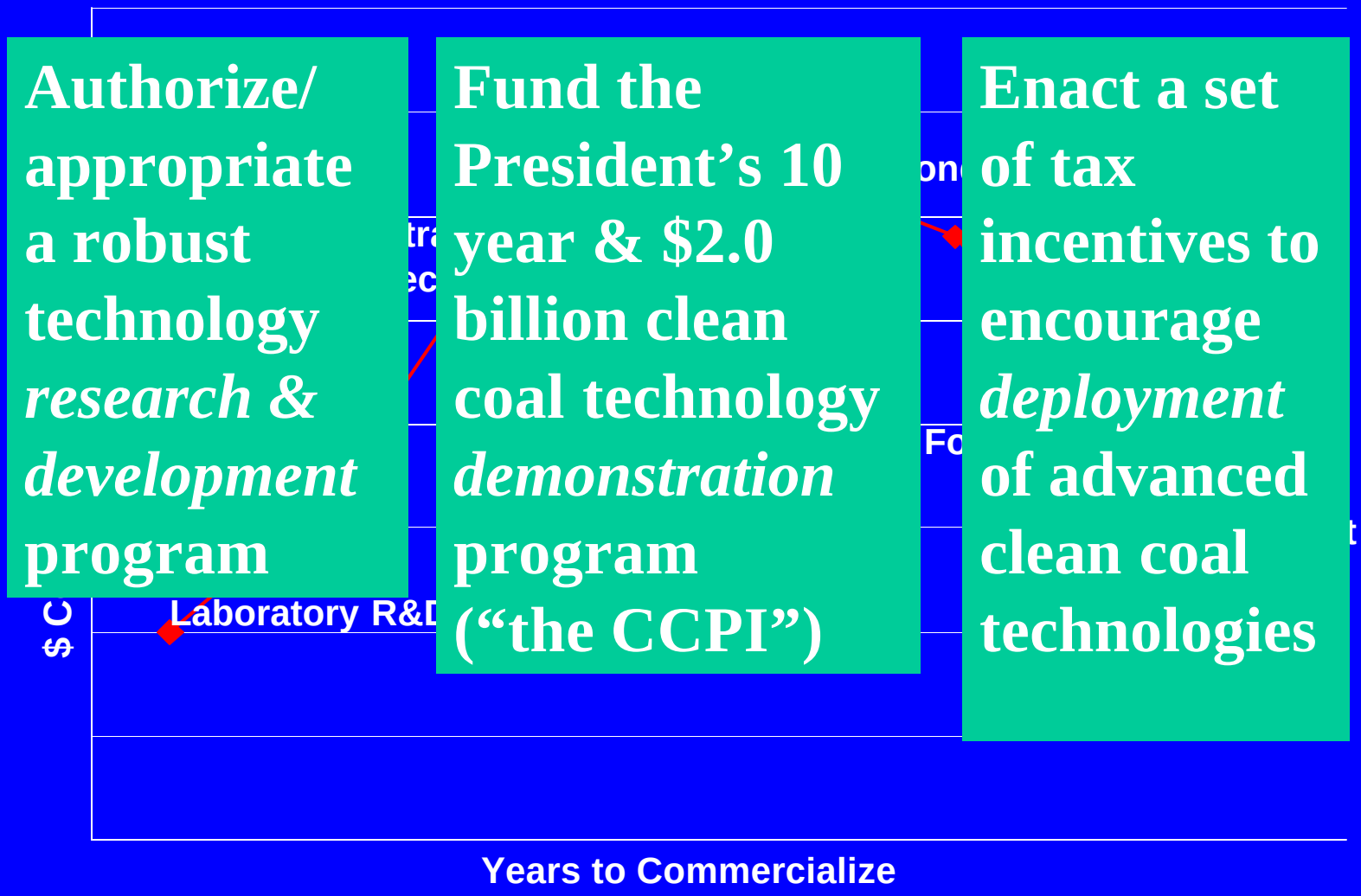
National Energy Legislation

- Keyed to the CURC Technology Roadmap requirement
- DOE authorizations to focus upon specific CURC Roadmap technologies
- Authorization of the $2.0 B CCPI
- Tax incentives for existing and new power plants utilizing advanced coal technologies
- Directive to DOE to undertake a coal R&D “road mapping” exercise

Technology R&D to Commercialization



Technology R&D to Commercialization



Authorize/ appropriate a robust technology *research & development* program

Fund the President's 10 year & $2.0 billion clean coal technology *demonstration* program ("the CCPI")

Enact a set of tax incentives to encourage *deployment* of advanced clean coal technologies

Does H.R.6 Implement the Roadmap?

Subtitle E – Fossil Energy Sec. 21501 $300+million/ year for coal-based R&D authorized (not yet appropriated)

Division E Clean Coal Sec. 50001 Authorizes the President's Clean Coal Power Initiative $2 billion over 10 years (so far $300 million appropriated)

H.R. 6 contains no tax incentives for clean coal

Coal Technology R&D Program

The current track record vs. Roadmap Requirements (also reflected in HR 6)

SUMMARY CURC OF FY 2004 BUDGET RECOMMENDATIONS

Technology Program (All figures in $Millions)	Administration FY 2004 Request	CURC Roadmap Annual R&D Budget[1]	CURC FY 2004 Budget Recommendation[2]
IGCC/Gasification	51.0	106.0	62.0 (+11.0)
Pressurized Fluidized Bed Systems (PFD)	0.0	14.0	12.0 (+12.0)
Advanced Turbines	13	15.0 Specifically for syngas from coal	23.0(+10.0) Specifically for syngas from coal
Innovations for Existing Plants	22.0	43.0	32.0 (+10.0)
Carbon Sequestration	62.0	84.0	52.0 (-10.0)[3]
Advanced Research For Advanced Materials Only	4.7	4.0	4.7
Coal Derived Fuels & Liquids	5.0	13.0	12.0 (+7.0)
TOTAL R&D	**157.7**	**279.0**	**197.65 (+40.0)**
Clean Coal Power Initiative	130.0	240.0	150.0
TOTALS	**287.7**	**519.0**	**347.65 (+60.0)**

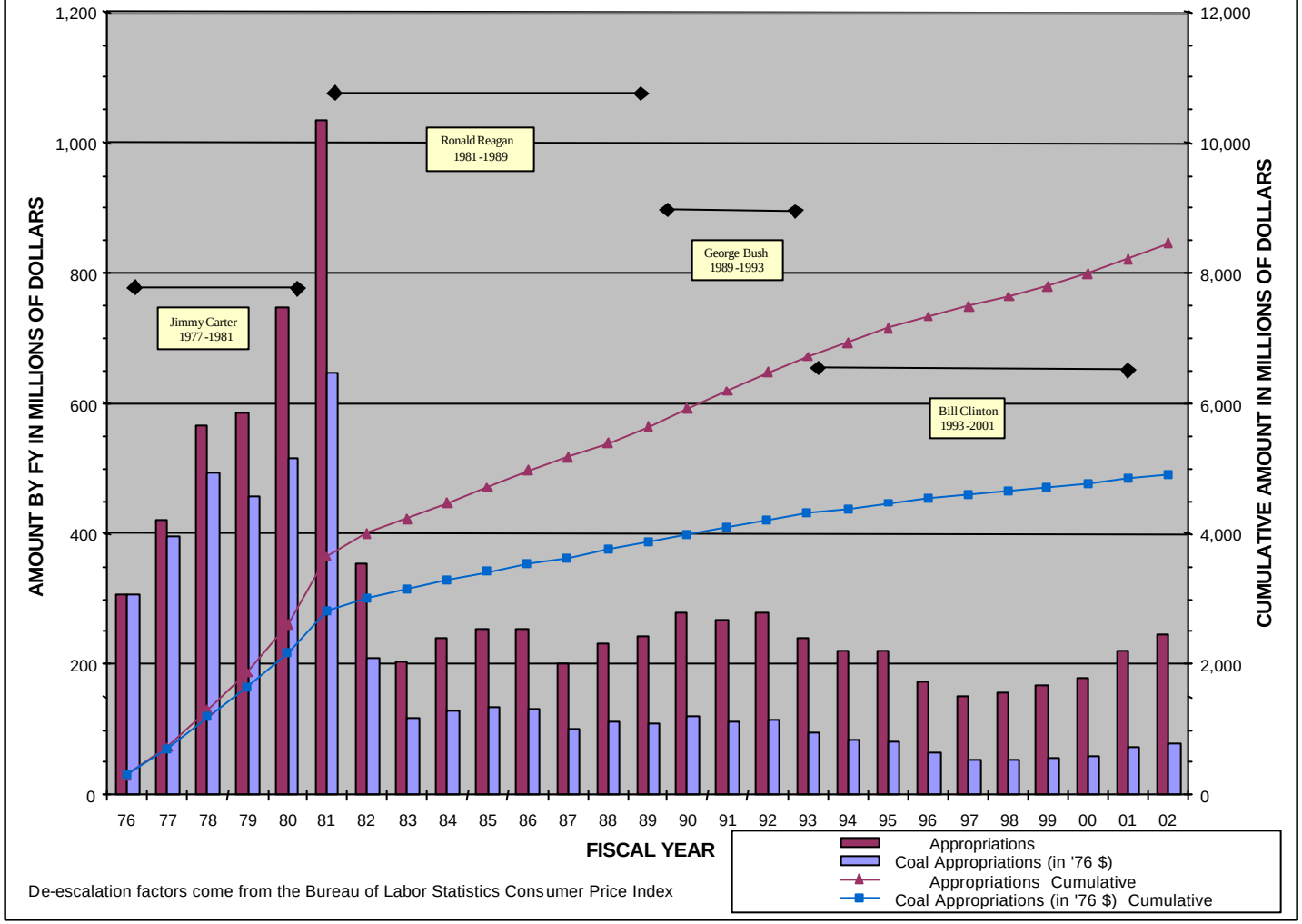
FY 2004 request is inadequate

[1] This number is 80% of the total R&D amount required and represents the federal contribution. It is assumed that industry will provide the other 20% required to carry out the R&D.

[2] CURC recommendations are a recognition of budget reality not technical need nor societal benefit

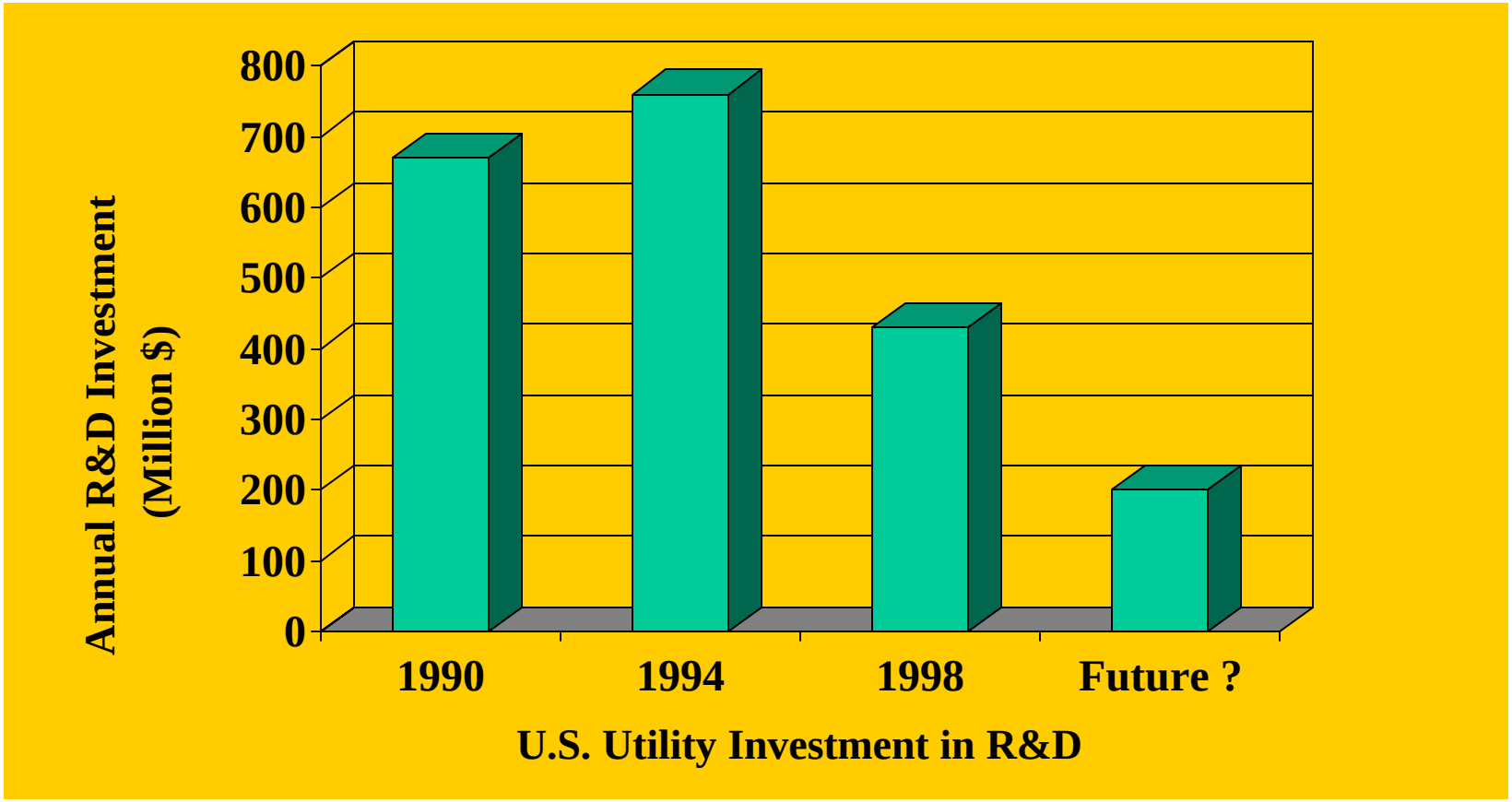
[3] At this stage of technology development these funds should be spend primarily on capture rather than sequestration

DOE COAL R&D ACTUAL APPROPRIATIONS NOMINAL DOLLARS VS 1976 DOLLARS



De-escalation factors come from the Bureau of Labor Statistics Consumer Price Index

Downward Investment Trend By Utilities



Source: EPRI Roadmap

DOE's Coal Combustion Program

- **This program is in TROUBLE!**
  - No budget requested in FY 2004
  - Perception in the Administration that gasification not combustion is the future
- **Industry & academia must provide direction and advocacy if combustion is to be supported**

CURC's Role in Combustion

- **Advocating continued funding for the program**
  - **$3 to $5.0 million in FY 2004 (DOE request zero)**
  - **Change name of the program – "Advanced Combustion Systems"**
  - **Adopt the Technology Roadmap for Combustion**
  - **Define reasons to be relevant, e.g. CO_2 capture**

CURC's 4-point Combustion Program

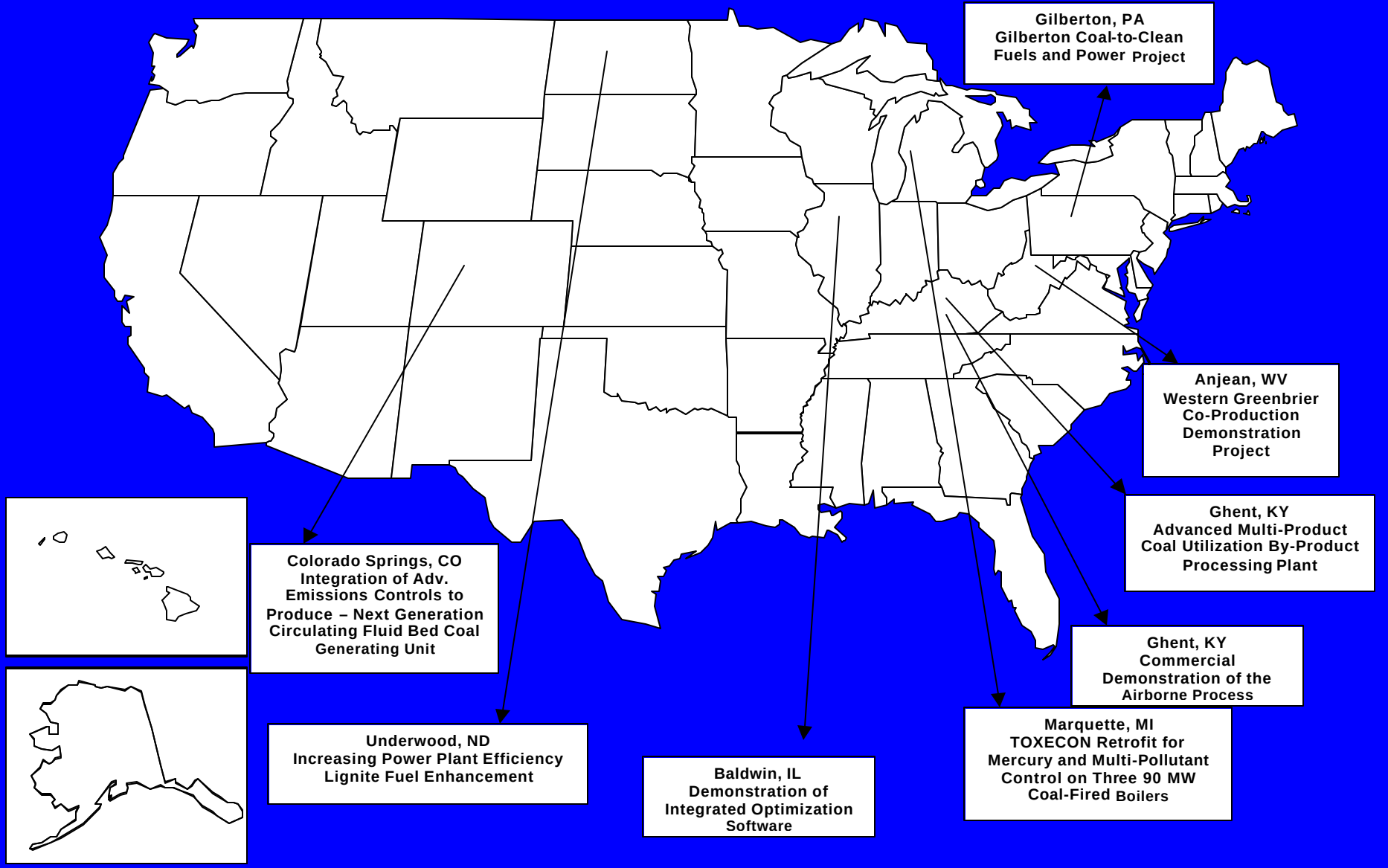
- Advanced combustion technologies able to capture/sequester CO2
- Hybrid powerplant systems
- Ultra-supercritical steam cycles
- Fund the Combustion Technologies University Alliance

- Will advocate funding of at least $12.0 million in FY 2005 to fund these programs

Coal Technology Demonstrations

The current track record vs. Roadmap Requirements (also reflected in HR 6)

CCPI Round 1 Projects



Clean Coal Demonstration Program

- **Round 1 is underway; 8 projects selected**
  - **Total estimated value of projects is $1.3B**
  - **DOE's anticipated contribution is $316M**
- **Round 2 expected to be undertaken in calendar year 2004/2005 but**
  - ***Only $130 million (not $200 million) is requested in FY 2004***
- **FutureGen -- $1.0 billion project**
  - **Industry & government partnership**
  - **Hydrogen production & CO_2 management**

Coal Technology Deployment

The current track record vs. Roadmap Requirements (also reflected in HR 6)

Deployment of CCTs (tax incentives)

- **Senate's Energy bill S. 517**
  - **4000 megawatts of a[illegible] technology app[illegible]**
  - **4000 me[illegible] for existing p[illegible]**

No tax incentives in House Energy bill

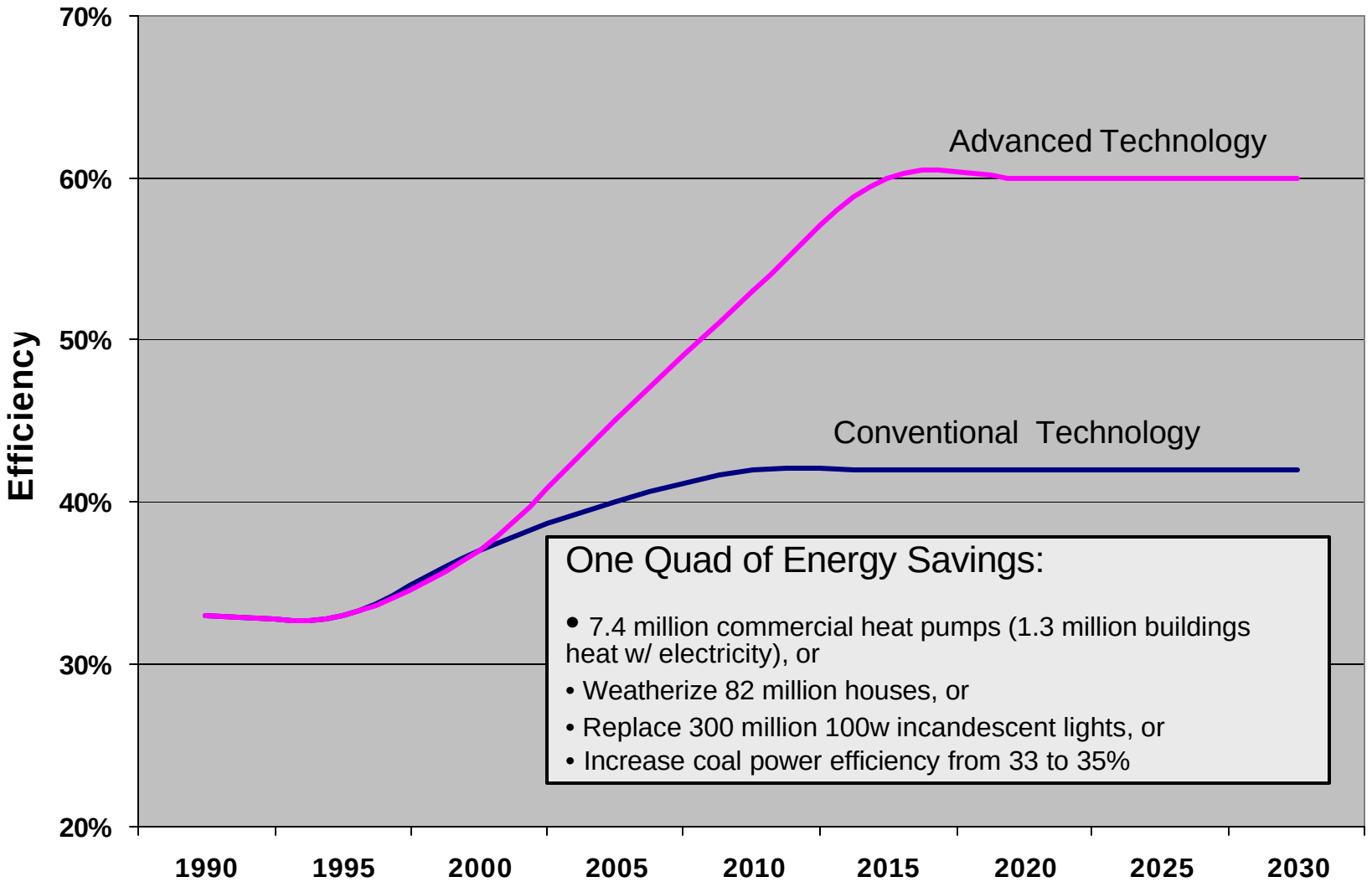
Energy Legislation

ncentives for clean coal

Where are we? August 4, 2003

- FY 2004 budget request -- Inadequate?
- Clean Coal Power Initiative underway
  - 8 projects selected in Feb. 2003
  - 2nd solicitation expected in 2004 or 05
  - Funding may be inadequate
- Comprehensive energy legislation passed last week by the U.S. Senate
  - Authorizations will further Roadmap goals
- Variety of problems -- tax incentives!!

Coal Power Technology



For More Information:

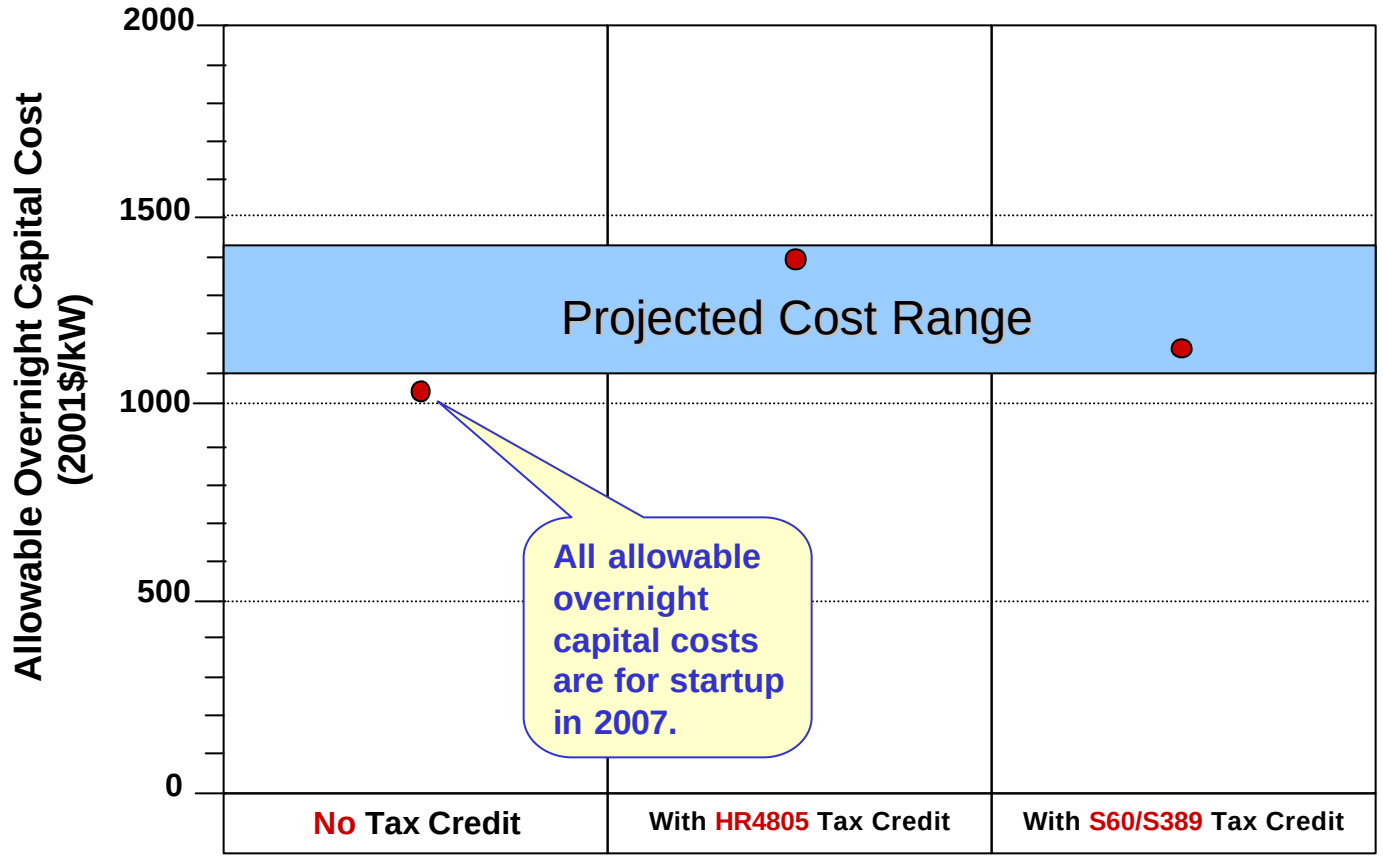
Contact:

Coal Utilization Research Council
1050 Thomas Jefferson Street, N.W., #700
Washington, DC 20007

www.coal.org

How Much Capital Can be Invested in a Coal Plant?

Overnight capital investment that can be justified for a first-of-a-kind coal-fired plant to break even with a natural gas-fired combined cycle plant.



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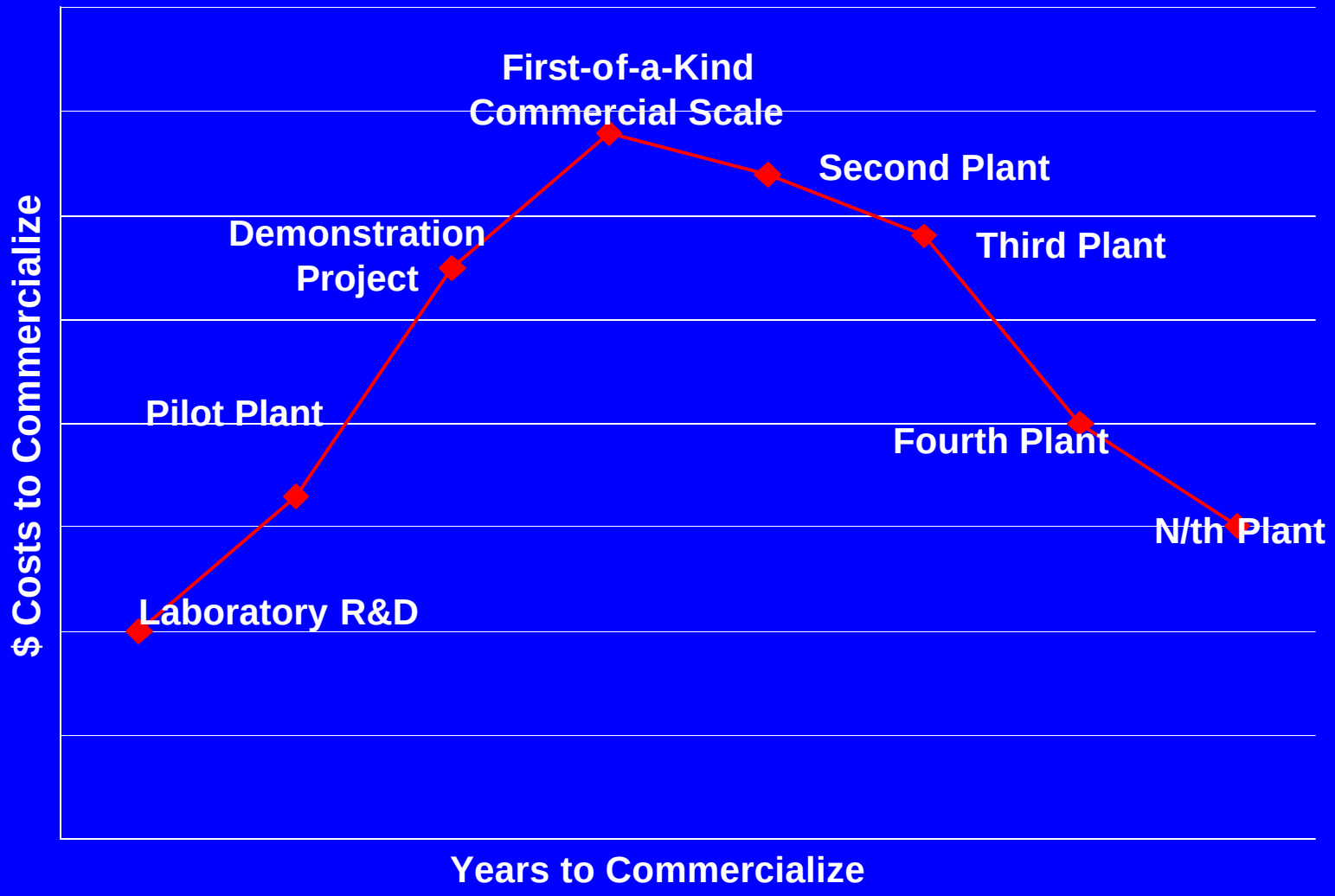
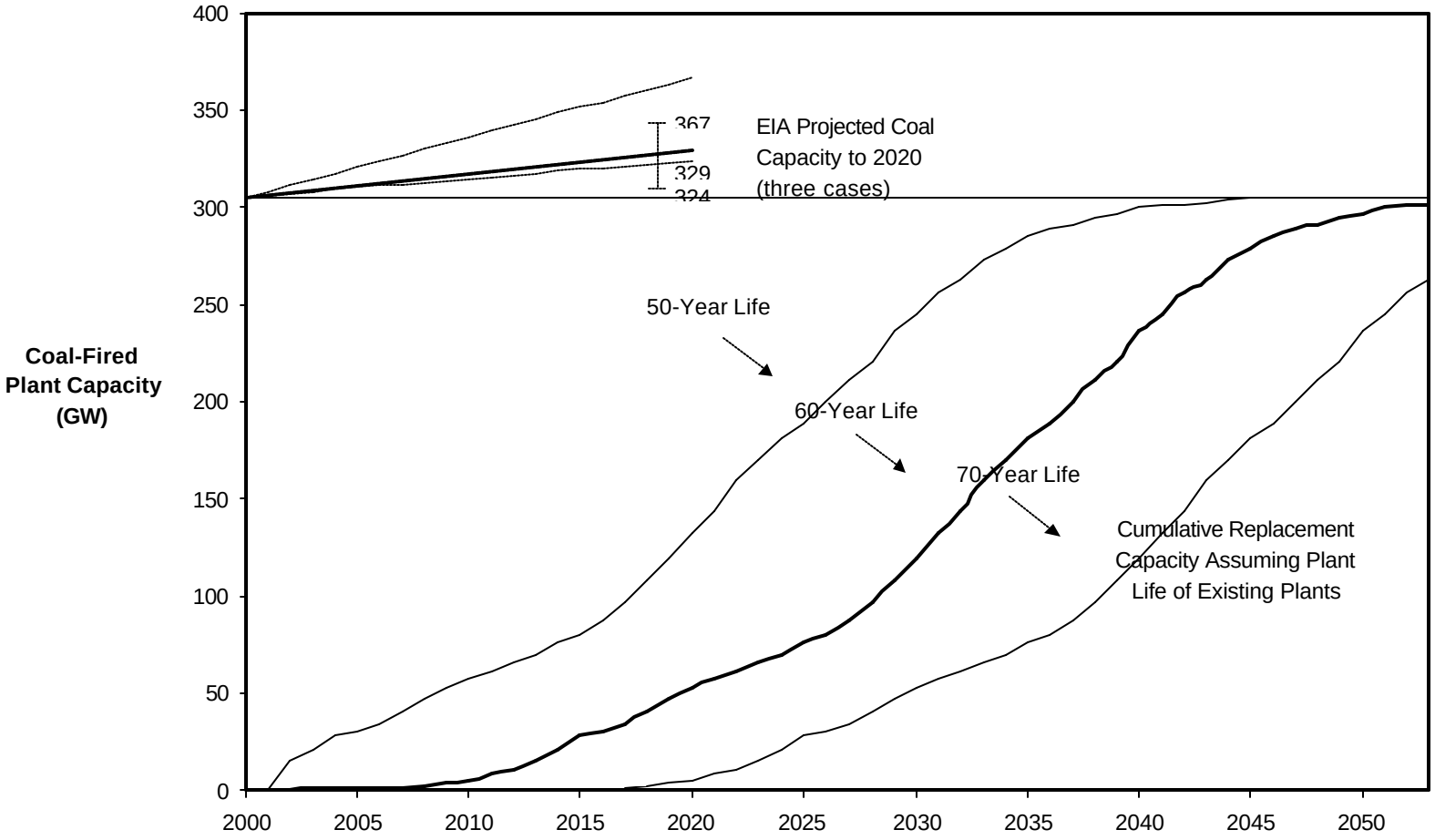
Technology R&D to Commercialization



The Market for New Coal Power Plant Technology



National Energy Legislation (2002)

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Legislation introduced in the House by Congressmen Whitfield & Boucher & others; Chairman Barton's bill & Chairman Boehlert's R&D bill

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Legislation introduced in the Senate by Senator Bunning and by Senator Byrd & 11 others; Energy Committee's staff draft; & Finance Committee's energy tax bill